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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/853,661	05/14/2001	Masahiro Tanaka	208546US2	6508

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ALEXANDRIA, VA 22314

EXAMINER

DIAZ, JOSE R

ART UNIT	PAPER NUMBER
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2815

DATE MAILED: 05/09/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/853,661

Applicant(s)

TANAKA, MASAHIRO

Examiner

José R Díaz

Art Unit

2815

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 February 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-8 and 16-18 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4-8 and 16-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

➤ The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

➤ Claims 1-2, 4-5 and 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Miller et al. (US Pat. No. 4,893,165) in view of Kuwahara (US Pat. No. 5,331,184).

Regarding claim 1, Miller et al. teach a semiconductor device (see Fig. 1) comprising: a first conductivity type semiconductor substrate (1,2); a second conductivity type impurity layer (15), wherein the impurity layer has a thickness of no more than 1.0 μm (see col. 2, lines 64-66); an first electrode (14); and a second electrode (10) (see Fig. 1). However, Miller et al. fail to teach a second conductivity type contact layer having a thickness of no more than 0.2 μm for the contact layer. Kuwahara teaches that it is well known in the art to form a second conductivity type contact layer (21) in the impurity layer (11), the contact layer being thinner than the impurity layer and having a higher impurity concentration than the impurity layer (see Fig. 1 and col. 3, lines 21-23, 29-32 and 43-48; and col. 5, lines 36-44). Furthermore, Kuwahara teaches that the thickness of the contact region (21) is, for example, at least 1/5 of the thickness of the impurity layer (see Figs. 1 and 6, and col. 3, 29-30 and 47-48). Please note that the ratio 1/5 is the result of dividing 2 μm (e.g. the thickness of the contact region) by 10

μm (e.g. the thickness of the impurity layer). Applicant should note that it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233. Therefore, it would have been obvious to one having ordinary skill in the art at the same time the invention was made to modify Miller et al. to include a contact layer being thinner than the impurity layer, having a higher impurity concentration than the impurity layer, and having a thickness of not more than 0.2 μm . The ordinary artisan would have been motivated to modify Miller et al. in the manner described above for at least the purpose of providing a good ohmic contact.

Regarding claims 2 and 17, Miller et al. teaches that the impurity layer (15) is provided for carrier injection from the impurity layer to the semiconductor substrate (see Figs. 1-2). However, Miller et al. fail to teach a second conductivity type contact layer. Kuwahara teaches that the contact layer is provided for reducing a contact resistant between the first electrode (19) and the impurity layer (11) and not for carrier injection (see col. 3, lines 54-68 and col. 5, lines 20-39). Therefore, it would have been obvious to one having ordinary skill in the art at the same time the invention was made to modify Miller et al. to include a contact layer for reducing a contact resistant between the first electrode and the impurity layer, and not for carrier injection. The ordinary artisan would have been motivated to modify Miller et al. in the manner described above for at least the purpose of providing a good ohmic contact.

Regarding claim 4, Miller et al. teach an IGBT device (see Figs. 1).

Regarding claims 5 and 18, Miller et al. teaches that the impurity layer (15) is formed in the entire one surface of the semiconductor substrate (see Fig. 1).

Regarding claim 16, Miller et al. teach a semiconductor device (see Fig. 1) comprising: a first conductivity type semiconductor substrate (1); a second conductivity type base region (5); a first conductivity type impurity region (6) formed in the base region; a gate electrode (8); a second conductivity type impurity layer (15), wherein the impurity layer has a thickness of no more than $1.0\text{ }\mu\text{m}$ (see col. 2, lines 64-66); a first electrode (14); and a second electrode (10) (see Fig. 1). However, Kuwahara fails to teach a thickness of no more than $1.0\text{ }\mu\text{m}$ for the impurity layer and a thickness of no more than $0.2\text{ }\mu\text{m}$ for the contact layer. However, Miller et al. fail to teach a second conductivity type contact layer having a thickness of no more than $0.2\text{ }\mu\text{m}$ for the contact layer. Kuwahara teaches that it is well known in the art to form a second conductivity type contact layer (21) in the impurity layer (11), the contact layer being thinner than the impurity layer and having a higher impurity concentration than the impurity layer (see Fig. 1 and col. 3, lines 21-23, 29-32 and 43-48; and col. 5, lines 36-44). Furthermore, Kuwahara teaches that the thickness of the contact region (21) is, for example, at least $1/5$ of the thickness of the impurity layer (see Figs. 1 and 6, and col. 3, 29-30 and 47-48). Please note that the ratio $1/5$ is the result of dividing $2\text{ }\mu\text{m}$ (e.g. the thickness of the contact region) by $10\text{ }\mu\text{m}$ (e.g. the thickness of the impurity layer). Applicant should note that it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233. Therefore, it would have been obvious to one having ordinary skill in the art at the same time the invention was made to modify Miller et al. to include a contact layer being thinner than the impurity layer,

having a higher impurity concentration than the impurity layer, and having a thickness of not more than 0.2 μm . The ordinary artisan would have been motivated to modify Miller et al. in the manner described above for at least the purpose of providing a good ohmic contact.

Response to Arguments

➤ Applicant's arguments with respect to claims 1-2, 4-8, and 16-18 have been considered but are moot in view of the new ground(s) of rejection.

Correspondence

Any inquiry concerning this communication or earlier communications from the examiner should be directed to José R Díaz whose telephone number is (703) 308-6078. The examiner can normally be reached on 9:00-5:00 Monday, Tuesday, Thursday and Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (703) 308-1690. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 746-3891 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

JRD
May 4, 2003


EDDIE LEE
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800